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Subscribed and sworn to before me this 30th day of May, 2006.

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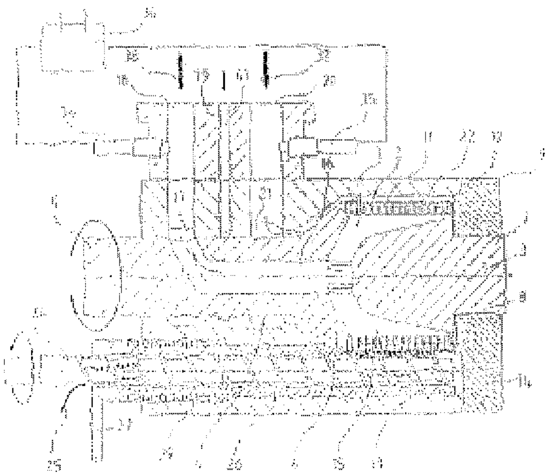
DEVICE FOR CONTINUOUSLY FILTERING MATERIAL MIXTURES



(57) **Abstract:** The invention relates to a device which is used to continuously filter material mixtures, in particular for separating impurities from plastic melts. Said device comprises a hollow cylindrically-shaped filter element (2) which is arranged inside a housing (1), an annular chamber (22) which is defined from the outside of the filter element (2) and an inner wall of the housing, and at least one stripper (23) which can be pressed onto the filter body by means of an adjusting device, said stripper being used to remove the impurities detained on the filter element (2) due to a relative movement of the filter element (2) and the stripper (23). The adjusting device contains a pressure sensor (42, 53) which is used to detect the pressure of the material mixture upstream from the filter body and an actuator (43) which is connected to the pressure sensor, said actuator being used to adjust the pressure of the stripper (23) according to the pressure detected by the pressure sensor

The invention relates to a device for continuously filtering material mixtures, particularly for separating impurities from plastic melts, according to the preamble of Claim 1.

Used plastics or plastic waste typically have high percentages of foreign materials, e.g., metal parts, paper residue, glass, secondary plastics, and the like. Usually, these foreign materials or impurities must be removed before the plastics are reused. This is realized in several ways such that the used plastics are first plasticized by heating and the plastic melts are then filtered. For this purpose, so-called melt filters are used, through which the metallic or non-metallic foreign materials or higher melting point plastics are separated. However, to enable continuous and uninterrupted filtering, the melt filter must be cleaned continuously.

From US 4 470 904, a separating device according to the class is known, in which the contaminated plastic melts are pressed into the interior of a hollow, cylindrically-shaped filter body arranged in a housing. In the interior of the filter body, there is a rotationally driven stripper shaft, which is arranged coaxial to this filter body and which defines an inner annular space with the inner wall of the filter body and carries on its outer side several strippers at an angle to the axial direction and expanding into a spiral. The residue detained on the filter body on its inner

side is transported to a material outlet opposite the inlet end of the inner annular space in the axial direction along the filter body by the strippers through the rotation of the stripper shaft. The strippers are elastically pressed from their inner side onto the inner surface of the filter body. However, in such elastic contact of the strippers, there is the problem that the strippers can be lifted from the surface of the filter body due to the pressure of the plastic melts and thereby lose their effectiveness. On the other hand, too high a contact pressure leads to increased friction between the filter body and the strippers, which is associated with accelerated wear.

The problem of the invention is to create a device of the type named above, which enables improved removal of the residue detained on the filter element.

This problem is solved by a device with the features of Claim 1. Preferred improvements and advantageous embodiments of the invention are given in the subordinate claims.

An essential advantage of the device according to the invention is that the contact pressure of the stripper can be automatically modified to the actual conditions without intervention from the outside. For example, if the pressure of the fed material increases, thereby increasing the risk of the stripper being lifted, according to the invention, the contact pressure of the stripper is also automatically increased without intervention from the outside. In contrast, if the pressure of the fed material drops, then the contact pressure of the stripper is also reduced accordingly, thereby decreasing the friction between the stripper and the filter element.

In a preferred embodiment of the invention, the pressure sensor is a hydraulic pressure transducer, which detects the pressure of the fed material upstream from the filter element and converts it into a hydraulic control signal. The actuator consists of an adjusting cylinder connected to the hydraulic pressure transducer via a hydraulic line, through which the control pressure is converted into a contact pressure for the stripper.

However, the pressure sensor can also be an electronic pressure transducer, which delivers corresponding control signals for a pressure control valve or an electronic actuator.

In the device according to the invention, the filter residue is lifted from the filter surface in the radial direction and thus discharged on the quickest path from the filter surface. The residue is not pushed axially to the filter surface, so that the wear decreases and the stability of the device can be improved. Through the lower abrasive loads of the filter, simpler and more economical filters can also be used.

The material lifted by the stripper is preferably transported away by a spiral conveyor or the like. The filter element and the spiral conveyor can be driven separately, so that a separate control of cleaning and foreign material discharge speed is enabled. Through such control, a very high foreign material concentration can be effected and thus also a high yield of the primary material. In a preferred configuration, the conveying device comprises a rotationally motor-driven spiral conveyor. The rpm values of the filter and the spiral conveyor can be

controlled separately, whereby a very high impurity concentration for an optimally active filter surface can be achieved. According to the type of plastic, the filter and the spiral conveyor can have the same or opposite direction of rotation.

Further special features and advantages of the invention emerge from the following description of a preferred embodiment with reference to the drawing. Shown are:

Figure 1, a first embodiment of a separating device in a longitudinal section;

Figure 2, a cross section of the separating device from Figure 1;

Figure 3, a cross section of a second embodiment of a separating device;

Figure 4, a first embodiment of a contact device for pressing a stripper onto the filter tube, and

Figure 5, a second embodiment of a contact device.

The filter device shown schematically in Figure 1 for filtering contaminated plastic melts includes a housing 1, in which a hollow, cylindrically-shaped filter element 2 is rotatably arranged about a center axis 3. The filter element 2 is mounted on a motor-driven carrier shaft 4. This includes a narrow driving part 5 mounted in the housing 1, a wider holding part 6 for the melt filter 2, and a narrow bearing journal 7, which is rotatably mounted in a corresponding bore 8 of a bearing cover 9 fixed on the housing 1.

The filter element 2 comprises a filter tube 11 provided with a plurality of radial through-holes 10 and a hollow, cylindrically-shaped support body 12, which is connected to the carrier shaft 4 with a positive fit and onto which the filter tube 11 is shrunken. The sieve-like filter tube 11 can be produced, e.g., from a steel sheet, which has through-holes 10, which is bent and then welded into a tube. Preferably, it is made from a wear-resistant and corrosion-resistant steel and hardened. The filter tube 11 can also be provided with surface coatings, through which the wear resistance and other properties can be improved. The through-holes 10 are configured as bores with a cross section expanding in the flow direction. The through-holes 10 can taper conically, e.g., outwardly. On its outer side, the hollow, cylindrically-shaped support body 12 has several collection channels 13 configured as circular grooves or flat threads. Several radial outflow bores 14 spaced apart at equal angular intervals in the peripheral direction lead inwards from these channels.

As is clear from Figures 1 and 2, the radial outflow bores 14 open into axial collection slots 15, which are distributed within the carrier shaft 4 at the same angular intervals as the outflow bores across the periphery of the expanded holding part 6 and which form an inner space for collecting the filtered material. The collection slots 15 expanding in the flow direction lead to a central collection channel 16, which opens via an inclined section into a first annular channel 17 within the housing 1. From the first annular channel 17, a first side bore within the housing 1 leads to an outlet channel 18 of a connection piece 19. In the connection piece 19 there is also an

inlet channel 20, which leads via a second side bore within the housing 1 to a second annular channel 21 in the housing 1. This annular channel 21 connects to an annular space 22, which is limited between the inner wall of the housing 1 and the outer wall of the filter tube 11.

As is clear from Figure 2, a stripper 23, in the form of a blade or a doctor, running in the axial direction over the entire length of the filter tube 11 and contacting the outer side of the filter tube is arranged in the lower part of the housing 1, such that the residue or impurities detained on the filter element 2 are discharged in the radial direction on the shortest path without being entrained over the filter element. The stripper 23 is arranged at an angle to the outer surface of the filter element 2 and towards the direction of rotation of the filter element. In the shown configuration, the stripper 23 is arranged, e.g., at a contact angle α in the area of 45° to a center plane 40 of the filter element 2 and is pressed against the outer wall of the filter tube 11 by a contact device, described in more detail below and shown schematically in Figure 4. In the direct vicinity of the stripper 23, within the housing 1 there is a spiral conveyor 24, which is parallel to the center axis 3 of the filter element 2 and which is led along the outer side of the filter element 2 to an outlet opening. The spiral conveyor 24 is arranged such that the residue stripped radially by the stripper 23 is transferred directly to the spiral conveyor 24 and transported away to the outside from this conveyor in the direction of the arrow 25 of Figure 1. In the configuration shown in Figure 2, the stripper 23 is mounted on a hollow shaft 26, which surrounds the spiral conveyor 24 and which can rotate within the housing 1 and by means of an adjustment lever 27. Therefore, the contact angle α and the pressure force of the stripper 23 can be changed. In the hollow shaft 26, there are cooling channels 29 in the area of the material outlet of the spiral conveyor 24. Via these channels, the material transported through the spiral conveyor 24 can be cooled in order to form a thermal barrier.

The stripper 23 can also be mounted at a given angular position in the housing 1, as shown in Figure 3. The stripper 23 is guided displaceably there in a diagonal slot 31 in the housing 1 and is pressed against the outer side of the filter tube 11 by an actuator of a contact device, described in more detail below.

On the connection port 19, in the area of the inlet channel 20 there is an input-side mass pressure sensor 35, and in the area of the outlet channel 18 there is an output-side mass pressure sensor 34. These are connected to control electronics 36 for controlling the filter device. Thus, e.g., the rotational movement of the filter body 2 and the spiral conveyor 24 can be controlled as a function of a detected differential pressure by means of the control electronics 36. Therefore, it is possible to allow the filter element 2 and the spiral conveyor 24 to turn intermittently according to two given pressure values (max-min) and thus to reduce wear. Between the inlet channel 20 and the outlet channel 18 there is a drainage channel 41 through the connection port

19 and the housing 1. In this way, portions of foreign material can be prevented from reaching the side of the goods via the bearing position.

In Figure 4, a first embodiment of a contact device for pressing the stripper 23 configured in the form of a blade or an edge against the outer side of the filter tube 11 as a function of the pressure of the fed material mixture is shown. The contact device comprises a pressure sensor 42 for detecting the pressure of the material mixture upstream from the filter element 2 and an actuator 43 connected to the pressure sensor 42 for setting the contact pressure of the stripper 23 as a function of the pressure detected by the pressure sensor 42. For the hydraulic contact device shown in Figure 4, the pressure sensor 42 is a hydraulic pressure transducer with a pressure piston 45, which can move within a piston housing 44 and which is connected on one of its ends to a pressure bolt 46 extending opposite the piston housing 44. A pressure chamber 47 filled with hydraulic fluid is defined by the other end of the pressure piston 45 and the piston housing 44. The pressure sensor 42 is attached to the connection port 19, such that the pressure bolt 46 projects into the inlet channel 20.

The actuator 43 consists of an adjusting cylinder, which contains a pressure piston 33 displaceable within a cylinder housing 32 with an outwardly projecting piston rod 48. The front end of the piston rod 48 is connected to the stripper 23. With the cylinder housing 32, the rear end surface of the pressure piston 33 borders a pressure chamber 49, which communicates with the pressure chamber 47 of the pressure sensor 42 via a hydraulic line 50. Within the cylinder housing 32, there is a compression spring 51 for generating a restoring force acting on the pressure piston 33. The adjusting cylinder can also be configured as a double-acting differential cylinder with an additional pressure connection 52 for the return movement.

Via the pressure bolt 46, the pressure of the material fed through the inlet channel 20 is transferred to the pressure piston 45, which generates a corresponding control pressure in the pressure chamber 46. This control pressure is also in the pressure chamber 49 of the actuator 43 via the hydraulic line 50 and ensures that the stripper 23 is pressed against the filter tube 11 via the pressure piston 33 and the pressure rod 48. If the pressure in the inlet channel 20 rises, the stripper 23 is also pressed more strongly against the filter tube 11.

In Figure 5, another possibility for a contact device is shown. There, an electric pressure transducer 53, which detects the pressure of the plastic melts within the inlet channel 20 and converts them into proportional electrical signals, is provided on the connection port 19. The signals delivered by the pressure transducer 53 are converted in control electronics 54 into corresponding control signals for a pressure control valve 55. The pressure control valve 55 is connected to the actuator 43 via a pressure line 56. Then, through the pressure control valve 55, the control pressure of the hydraulic actuator 43, and thus the contact pressure of the stripper 23, can be set as a function of the pressure detected by the pressure transducer 53.

In another embodiment, the actuator can also be configured as an electrical actuating drive, through which the contact pressure of the stripper 23 is set automatically as a function of the pressure detected by the electric pressure transducer 53.

In the previously described device, the non-treated material mixture (predominantly plastic mass) according to Figure 1 is pressed at the inlet opening 20 in the direction of arrow 37 under pressure into the annular space 22 and through the fine through-holes 10 in the filter tube 11 of the rotating filter body 2. The filtered material is led via the filter tube 11 and the support body 12 with the collection grooves 13 and the discharge bores 14 via the carrier shaft 6 to the outlet opening 18 and there can be removed in the arrow direction 38. The residue retained at the filter tube 11 is lifted away by the stripper 23 when the filter tube 11 rotates and transferred directly to the rotating spiral conveyor 24 without further contacting the filter. The residue can then be transported from the spiral conveyor 24 to an output and can there be discharged in the arrow direction 25.

The invention is not restricted to the previously described embodiment. Thus, filtering can also be performed, e.g., with a flow direction directed from the inside outwards, wherein the stripper is then attached to the inner side of the hollow, cylindrically-shaped filter body. The filter element can also be stationary and the stripper can rotate.

Claims

1. Device for continuously filtering material mixtures, especially for separating impurities from plastic melts, with a hollow, cylindrically-shaped filter element (2) arranged within a housing (1), with an annular space (22) defined by the outer side of the filter element (2) and the inner wall of the housing (1), and with at least one stripper (23), which can be pressed against the filter body (2) by means of a contact device for removing impurities detained on the filter element (2) due to the relative movement of the filter element (2) and stripper (23), characterized in that the contact device contains a pressure sensor (42, 53) for detecting the pressure of the material mixture upstream from the filter body (2) and an actuator (43) connected to the pressure sensor (42) for setting the contact pressure of the stripper (23) as a function of the pressure detected by the pressure sensor (42).

2. Device according to Claim 1, characterized in that the pressure sensor is a hydraulic transducer cylinder (42).

3. Device according to Claim 2, characterized in that the hydraulic transducer cylinder (42) contains a pressure piston (45) displaceable within a piston housing (44) and a pressure bolt (46) projecting into an inlet channel (20).

4. Device according to one of Claims 1-3, characterized in that the actuator (43) is a hydraulic adjusting cylinder (32, 33, 48).

5. Device according to Claim 4, characterized in that the hydraulic adjusting cylinder (32, 33, 48) contains a pressure piston (33) displaceable within a cylinder housing (32) and a piston rod (48) connected to the stripper (23).

6. Device according to one of Claims 1-5, characterized in that the pressure sensor (42) and the actuator (43) are connected to each other via a hydraulic line (50).

7. Device according to Claim 1, characterized in that the pressure sensor is an electric pressure transducer (53).

8. Device according to Claim 7, characterized in that the electric pressure transducer (53) is connected to the actuator (43) via control electronics (54) and a pressure control valve (55).

9. Device according to one of Claims 1-8, characterized in that the filter element (2) is arranged within the housing (1) so that it can rotate motor-driven about a center axis (3).

10. Device according to one of Claims 1-9, characterized in that the stripper (23) is arranged diagonal to the filter element (2).

11. Device according to one of Claims 1-10, characterized in that the stripper (23) is arranged at a contact angle (α) relative to a center plane (40) of the filter element (2).

12. Device according to Claim 11, characterized in that the contact angle (α) of the stripper (23, 28, 30) is variable.

13. Device according to one of Claims 1-12, characterized in that in the housing (1) there is a spiral conveyor (24) in the direct vicinity of the stripper (23) for transporting away the impurities removed radially by the stripper (23, 28, 30) from the filter element (2).

14. Device according to Claim 6, characterized in that the rotating motor-driven filter (2) and the spiral conveyor (24) can be driven separately.

15. Device according to Claim 8, characterized in that the rpm of the filter element (2) and the rpm of the spiral conveyor (24) are separately controllable.

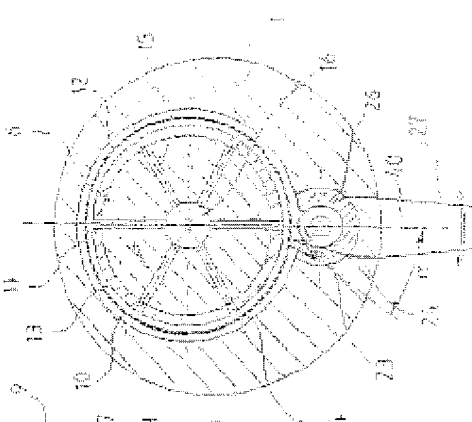


Fig. 2

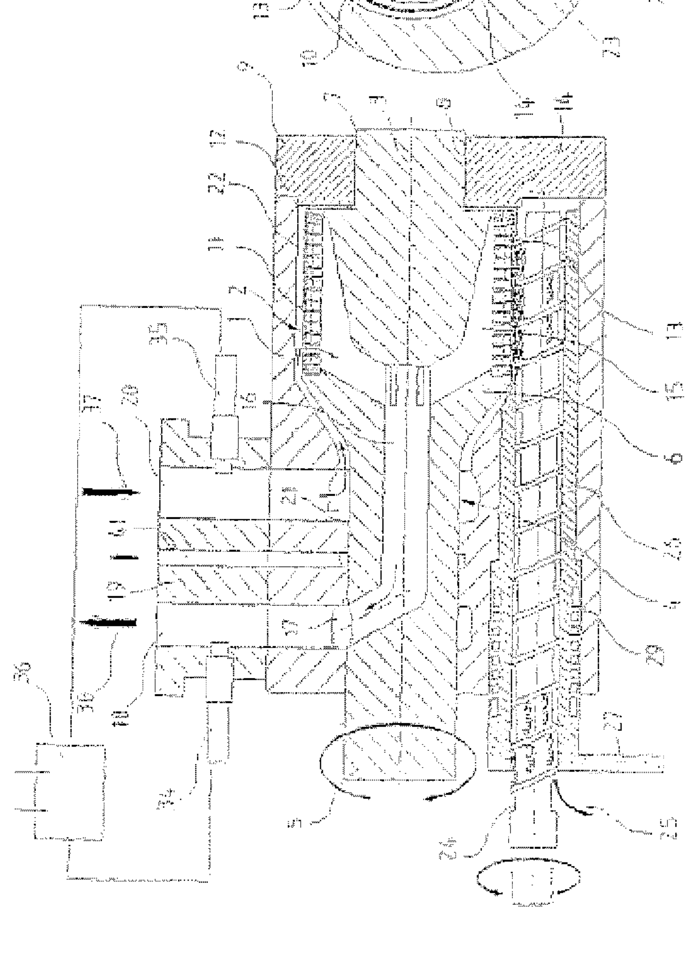


Fig. 1

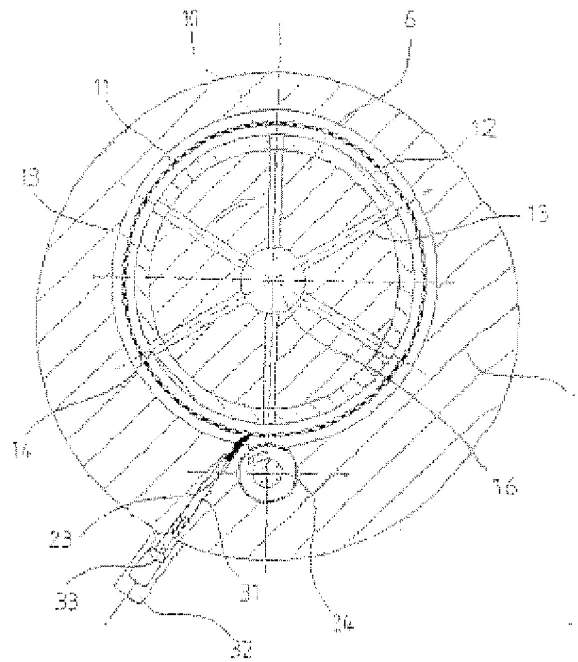


Fig. 3

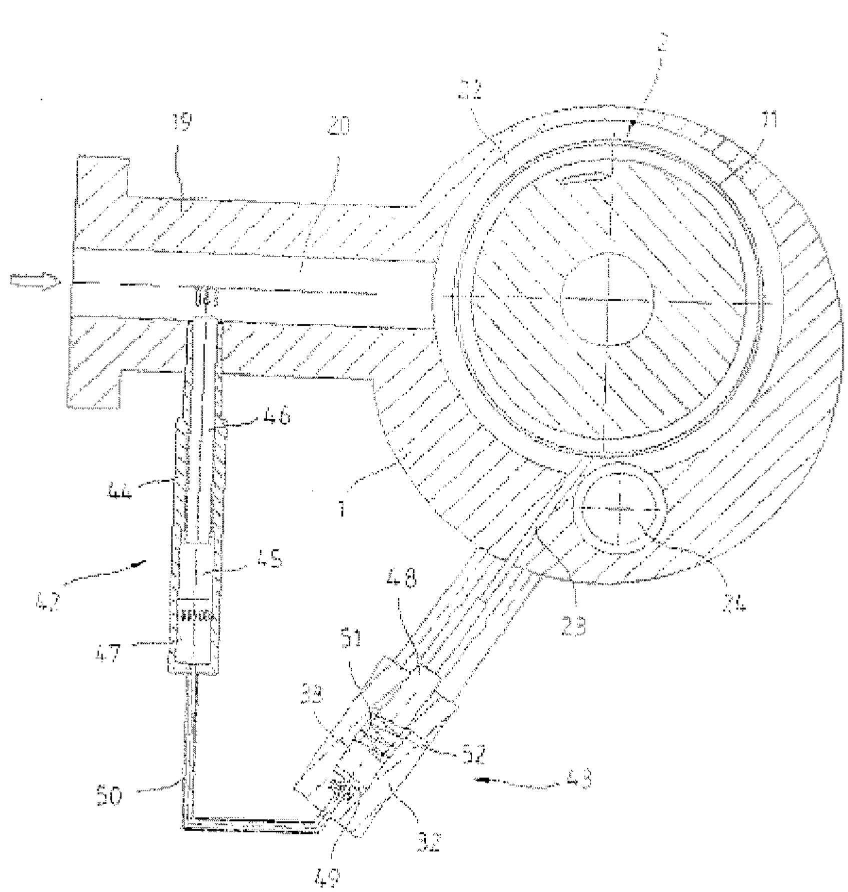


Fig. 4

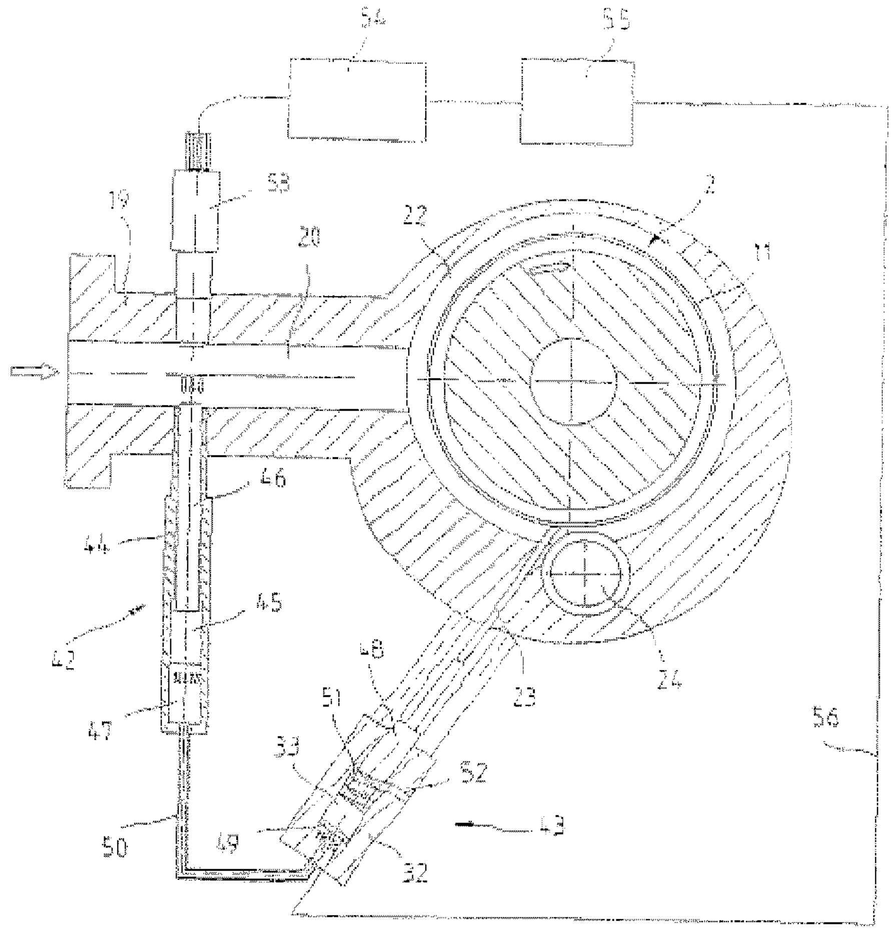


Fig. 5